Linear Shaped Charge Array Draping Study

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LONG-TERM GOALS

The long-term goal of this effort is development of the interrelated warhead and deployment technology needed for the design of a weapon with the capability to breach obstacles on the beach and in the surf.

OBJECTIVES

The technical objective of this task is development of design tools and data that can be used in system effectiveness studies. The primary focus of the effort at this time is determination of how an array of linear shaped charges drapes over the different obstacle types and identification of variables affecting draping in order to minimize stand-off between the charges and targets and minimize the amount of material to be cut.

APPROACH

The proposed technical approach is as follows:

1. Based on assumptions of how an array of linear shaped charges (LSC) might drape over several different obstacle types, determine amount of material required to be cut in order to defeat the target. Based on these cutting requirements, select the size, cross-section and explosive load, of the linear shaped charge. Also, based on the same draping assumptions select a LSC segment length. Windsor Furr of Indian Head performed this work.

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2. Predict loads in strength members during deployment from the Magic Carpet glider assuming the selected LSC size and weight. Jack Holt of CSS is performing this analysis using a 1/5 scale Beach Zone Array deployment model.

3. Based on load prediction, select a strength member for use in the draping tests. All principal investigators will be involved in strength member selection.

4. Design LSC-to-strength member attachment method. Windsor Furr and Tim Hennessey will perform this work.

5. Design an array support structure, from which the array will be suspended and released, that will keep the array spread out during drop testing. Select and procure mechanisms that will release the array from that structure during drop testing. Tim Hennessey is performing this work.

6. Fabricate eight full-scale obstacles of four different types, tetrahedrons, hedgehogs, log posts or simulants, and concrete cube simulants (plywood not concrete). Tim Hennessey is contracting this work to a local machine shop.

7. Procure materials and fabricate a 10'x10' subarray and support structure with release mechanisms. Perform drop tests of this subarray onto several obstacles of different types. This will be a "shakedown" for the larger array (40'x40') tests allowing refinements of the support structure, release mechanisms, and the array itself. These tests do not require the special facilities, meaning a large building with an overhead crane, that the large array tests will; existing facilities at NSWCIH will be used. Windsor Furr and Tim Hennessey will perform this work.

8. Procure materials and fabricate a 40'x40' array and support structure with release mechanisms. Perform drop tests of this array onto a field of 8 obstacles of one type. Measurements will be recorded in order to determine how much of the obstacle would be cut. This process will be repeated for each obstacle type previously noted. The presence of lateral strength members and their effect on draping will be explored. Windsor Furr and Tim Hennessey will perform this work.

WORK COMPLETED

- Linear shaped charge size has been selected at 3200 grains per foot. Initial segment length has been selected at 8 inches.

- Deployment analyses have been completed by CSS. Peak "snatch" loads have been estimated to be 11,500 pounds.

- Selection of a strength member based on the 11,350-pound load is in progress.

- Concepts for the array support structure have been generated and a design will be finalized by mid November. Several release mechanism types have been identified.

- Tetrahedrons and hedgehogs have been fabricated.

RESULTS

The array characteristics that will have the most effect on draping are thought to be weight and length of the individual segments of LSC and stiffness of the strength members. The LSC size has been selected at 3200 grains per foot and eight-inch segment length. Strength member selection is in progress now that peak "snatch" loads have been predicted. Selection of LSC and strength members that would represent a realistic array is important if data collected from draping tests is to be realistic.

IMPACT/APPLICATIONS

The linear shaped charge array may be the only concept that can defeat obstacles on the beach and in the surf in a cost and time efficient manner. PMS-407 is expected to perform an Analysis of Alternatives (AOA) in 2003; at this time, it is unclear how many alternatives really exist. Much emphasis has been placed on MK 80 series bombs. If no other concepts, such as the LSC array, are investigated to the point where they can be considered in the AOA, then a true AOA will not be possible. The Marine Corps needs obstacle breaching capability and the developers should have more than one choice.

TRANSITIONS

None at this time.

RELATED PROJECTS

Concrete Obstacle Vulnerability Task-Linear shaped charges of 3200 grain per foot were demonstrated to significantly damage four-foot concrete cubes.

REFERENCES

1. J. Goeller, 1995: "Assessment of Obstacle Breaching Concepts," NSWC/DD/DL, Weapons Systems Department, July. (letter report)

2. J. Renzi, et al, 1998: "Concrete Obstacle Vulnerability," Naval Surface Warfare Center, Indian Head Division, IHTR 2126, 30 September. (in press)